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A. C. TRUE, Director.

FOOD CUSTOMS AND DIET IN AMERICAN HOMES

BY

C. F. LANGWORTHY, PH. D.,

Expert in Charge of Nutrition Investigations, Office of Experiment Stations.

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UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., January 23, 1911.

SIR: I have the honor to transmit herewith and to recommend for publication as a circular of this office an article on food customs and diet in American homes, prepared by C. F. Langworthy, expert in nutrition, in charge of nutrition investigations of this office.

The present circular is a revision and extension of an article by Dr. Langworthy which was published in the Yearbook of the department for 1907, and discusses popular ideas regarding diet, food habits and their origin, methods of making and recording food investigations, and a summary of the results obtained, the kinds of food eaten in American homes, the adequacy of the average American diet, and other questions which have to do with the use in the home of agricultural products. The information summarized is very largely drawn from the results of the experiments carried on and the data collected as a part of the nutrition investigations of this office, and the circular is similar in purpose and scope to popular publications which the department has issued in the past dealing with different food topics.

Respectfully,

A. C. TRUE,
Director.

Hon. JAMES WILSON,
Secretary of Agriculture.

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FOOD CUSTOMS AND DIET IN AMERICAN HOMES.

INTRODUCTION.

Each country and each epoch has its special food problems. During the last four hundred years and more the United States has passed on from the conditions prevailing in a newly discovered country with only a small area under cultivation and has become a producer of food and other great staple products not only for its own people, but also for export to other nations. An equally great change has taken place with respect to the different regions of the United States. As the country has been developed frontier conditions in living have receded, until to-day, as never before, the food problems of country and town are approaching each other, and it is no longer the case that the rural community is, as regards its supply of staple food, largely independent and the urban community largely dependent. Each must rely on the other, for in general the farm-grown crop is milled and the live stock is slaughtered in the large establishment where facilities are adequate, as they could not be in the case of a home enterprise. And, indeed, in all economic ways the two regions are perhaps more naturally interdependent than ever before.

All this means that many problems related to food demand study in order that the best use may be made of agricultural food crops by the farmer who grows them, the manufacturer who converts the raw material into food products, the merchant who supplies the food to the household, and the housewife who selects and prepares it for the family table.

Some of the problems which pertain to this subject have been studied by the Department of Agriculture, and a summary of data which have been gathered regarding food conditions as a whole, the characteristics of the American diet, and the special problems of housekeepers in both country and town seems desirable.

POPULAR IDEAS REGARDING DIET.

The majority of persons get their ideas of the food habits of a race or region from popular writings, and often the source of information is inaccurate or incomplete. If a writer states that the diet in New England is pork and beans and brown bread, or that in the South it is

corn meal and pork, everyone knows that the statement is very inadequate. With the question of diet in less familiar regions the discrepancy is not so obvious.

It is often said and is generally believed that the diet in the United States is generous and that the range in variety of food products is unusually large. The dietary combines many customs and food habits of the races which have helped to make up the population, but in its general character it is British, as is natural, for the bulk of the earlier settlers were from Great Britain and brought the customs and manners of the old home with them, adapted them to the new country, and passed them on to the succeeding generations. As time has passed marked changes in the character of the diet have taken place, owing largely to improved methods of cultivation of food crops, to better methods of transportation and storage, to improvements in milling and other manufacturing processes which pertain to food, to improvement in house construction and kitchen appliances, and to similar factors. Whether the value of the daily diet has changed when considered from the standpoint of the amount of nutritive material supplied is another matter, and one which is more difficult to decide.

As an illustration of changed food conditions, facts relating to the diet in public institutions may be of interest, as it seems fair to say that such a ration bears the same relation to the food habits of any one period as does a corresponding one to those of another. In an account of the diet in a large institution in Boston in 1850 a very simple ration was supplied in which bread, molasses, potatoes, and salt pork were the staples. In recent studies carried on in the same city in a similar institution the ration is much more varied and contains many articles, such as oatmeal, fresh and dried fruits, tapioca, and sago, which would have been considered luxuries in most homes in 1850.

It is not without interest to consider in more detail some of the factors which have modified dietary habits. In northern regions of the United States, in earlier times, the vegetable supply in the summer was fairly abundant, but in the winter was limited to a few varieties, chiefly root crops, which were of good keeping quality. Eggs, salt meats, and less commonly poultry were staple summer foods, but fresh beef, mutton, and pork were much more abundant in winter than in summer because they could be kept in good condition frozen. The lack of variety of vegetable foods in winter and of fresh meat in summer was without doubt the reason for the great abundance of preserves and pickles which every housewife deemed necessary, and for the great number of kinds of pastry, cake, and similar dishes. In other words, there was a craving for variety, and it was satisfied by using in many different ways the compar-

atively small number of food materials which were most commonly obtainable. With improvements in crop growing and in transportation, storage, and marketing of foods there is much less seasonal variation in the food supply and consequently much more uniformity in the diet at different seasons of the year.

FOOD HABITS AND THEIR ORIGIN.

The food of any individual or family is to a very large extent determined by circumstances. It is unreasonable to suppose, as many popular writers seem to have done, doubtless led thereto by Plato's reasoning on the subject, that in some remote age of the past the race lived upon fruits, nuts, and other similar foods exclusively, and that, owing to circumstances which are not set forth, it was diverted from such an existence and adopted the omnivorous habits which have since characterized it. Anthropologists claim, and with good reason, that in the earliest days of the human race man lived without much choice on the food which he could obtain, being fitted by his inheritance from earlier forms of life to use a large variety of foodstuffs. If he happened to be an inhabitant of seacoast regions, shellfish and other sea food, which could be readily procured, were eaten in quantity. If he lived in inland regions where nuts, wild roots, and seed-bearing grasses were abundant, such foods were used, and no one can doubt that in all localities birds and their eggs and such other animal foods as were available were eaten.

In considering the human race as a whole there are three great epochs in man's diet, namely: (1) The early hunting period, in which man depended entirely on a natural supply of both animal and vegetable food; (2) the cooking period, in which man still used a natural supply of food but prepared it for use with the aid of heat; and (3) the so-called cibicultural or food-producing period—that is, the period in which man has depended upon the cultivation of both flocks and herds and field and garden crops, to supplement a wild supply of food.

Civilized man still obtains his fish supply largely from the rivers and other waters, but with this exception he has come to depend almost wholly on a food supply which is produced through his own efforts directed in the various lines of agriculture.

Such questions pertaining to the evolution of man's diet have been recently discussed at length by H. Campbell.[1]

In the remains of the cave dwellers of prehistoric times are found cracked, charred, and broken marrowbones, which show plainly that wild animals were used for food. In the same way in the remains of the prehistoric lake dwellers of Europe are found the grains which

[1] A system of Diet and Dietetics, edited by G. A. Sutherland, London, 1908, pp. 25–67.

made the bread of that remote period. If early man may be judged by the customs of very primitive races, like the Australian aborigines, which have persisted until the present time, insects, seeds, animals, roots, and, indeed, anything which could be eaten, were readily used.

A theory exists that the polar inhabitants are the direct representatives of man of the glacial epoch. If this be true, the food habits of the Eskimo of North America and other polar regions should supply data regarding similar conditions in that prehistoric age. The Eskimo from necessity lives almost exclusively on animal food, the energy yielding blubber and other fat and the meat protein making up a more or less well-balanced diet.

Of the food habits of the Indians of North America before their customs were modified by contact with white races, much information is available and is of interest as throwing light on the food of a race which may be said to have developed without being influenced by other peoples. The Indians lived not alone by hunting and fishing, but cultivated a number of food plants on an extensive scale. Maize, beans, pumpkins, and sunflowers were the most common food crops, Indian corn being easily first. Wild rice and acorns were eaten, but corn was the chief breadstuff, being eaten boiled and also made into cakes, and the corn dishes of to-day are direct descendants of those prepared by the Indians. All kinds of animals, birds, fish, and shellfish were eaten, and large supplies of such animal foods were smoked and dried for winter use. Nuts and fruits, fresh and dried, and many wild roots and bulbs also constituted important articles of diet. It is interesting to note that special provision was made to secure fat, and that bear fat and other animal fats were collected in quantity, as was oil from the sunflower seed, if the early chroniclers may be credited.

Here is found, with a race isolated from the rest of the world, the same varied diet of animal and vegetable foods which seems to have been universally followed since earliest times.

The food habits of those first Americans and their descendants of the present time have often been described and the amount of information which is available on the subject is large. Of recent publications may be mentioned the extended work of Hrdlička among the Indians now living in the southwestern United States and northern Mexico. The principal diet of these Indians, it is pointed out, is maize and wheat, though the latter is used less extensively. Next in importance are meat, fish, fat, and beans, the beans being especially valuable since the meat supply is limited, game being not very abundant and few domestic animals being kept for food. Melons and cactus fruits and other wild fruits and vegetables are used and are

often dried for winter use. Such articles make up the diet of these modern Indians.

In the Arctic regions at the present time as in the past the food is almost exclusively animal, because that is the only sort which is available in quantity. In the Tropics, where vegetable food is abundant and animal foods readily decay, plant products are and always have been of very great importance in the diet. In temperate regions all kinds of food may be secured, and it seems reasonable to suppose that all classes have always been eaten as they are to-day.

In general, the food habits of the human race are an expression of the thousands of years of experience in which man has sought to bring himself into harmony with his environment, and food habits have been determined, as regards materials selected, by available supply, man being by nature omnivorous.

As regards different regions it is found that the available food supply very largely determines the food habits for the family or group, as it was stated earlier that it does for the race. Thus in rural regions in the Southern States beef and mutton, which must be kept with ice after slaughtering, are less common food than poultry, which may be easily raised and kept alive until needed. In the same way corn meal and other corn products, which are readily available, have always been popular foods, as have cowpeas, gumbo, eggplant, sweet potatoes, and the large variety of other southern vegetables which are so palatable. In the cities where cold-storage plants and ice are common a greater variety of food products is possible than in the country, and this fact has a decided bearing upon the diet. Such facts as these are evident from a study of the results obtained from investigations carried on by the Office of Experiment Stations in Tennessee, Alabama, eastern Virginia, Georgia, and elsewhere in the South.

It is very often easy to trace the influence of environment, as well as food supply, on food habits. Thus in New Mexico the proximity to old Mexico, with its Spanish customs and its peculiar dishes, directly influences food customs, as is shown in the preference for frijoles, a small bean of distinctive flavor which is cooked in many ways, and for dishes in which Chili peppers of different sorts are important ingredients. The results of dietary studies in New Mexico and of other observations show that frijoles, corn dishes prepared in the Mexican manner, and similar foods, which may be regarded as peculiar to the region, constitute a large proportion of the total food supply.

Careful observations which have been carried on in American cities and towns in connection with the nutrition investigations of the Department of Agriculture in families of foreign birth or parentage make it clear that older persons rather uniformly abide by their previously acquired food habits, while the younger generations are adopting American customs.

In the case of Germany, England, and other European countries the information which is available regarding foods and food habits is large in amount, and the popular statements which are made concerning them are accurate in the main. It is by no means unusual, however, to find misstatements which only too often pass without question. For instance, the writers who describe the potato diet in parts of rural Ireland not infrequently omit to mention the skim milk or the bacon which goes with it. It is often said that the peasants in many regions of the continent "taste meat hardly once a year." A study of their diet usually shows that cheese, milk, and other foods are used to replace the meat they find too expensive, and that the diet is not actually so limited as at first sight it might seem to be. Mention is much less commonly made in popular writings of the great number of the wage-earners of these countries who have a generous and varied diet, as is evident from a careful study of the situation or of the recorded data on the subject. It should be remembered that the very limited diet, when it is found, is the result of circumstances and not of choice, for the races under consideration, if we may judge by the numerous records at hand, are now, as always, by preference users of a reasonably abundant mixed diet made up of many different foodstuffs.

Erroneous statements regarding food and diet in different eastern countries are very frequently met with, though in many cases the question has been so often studied that reliable information should be readily accessible. For instance, it is commonly said that Chinese, Japanese, and other oriental races live upon rice and that large amounts of severe physical work are performed on a few handfuls of this cereal per day. Careful study of oriental dietetics shows that although rice is undoubtedly one of the most important foodstuffs, it fills much the same place in the diet that wheat and other common starchy foods do in the diet of western races. In other words, it is simply the most common and abundant starchy food.

The Japanese use a large variety of vegetables and fruits, fresh and preserved, and have always eaten fish and fish products in quantity whenever they could be procured. Beans of various sorts and other legumes are also eaten, and the soy bean is used very exten-

sively for the preparation of bean cheese or bean curd, and this and other soy-bean products are used in great quantities and constitute a very important source of nitrogenous material.

In the case of the Chinese, accurate dietary studies are few in number, but there is an abundance of information regarding the character of the foods eaten. Domestic animals are much more abundant than in Japan, and pork and poultry of different sorts are eaten in large quantity, as are fresh and cured fish of all kinds, eggs, rice and other cereals, sesame oil, bean oil, fruits, and vegetables. Judging from the accounts of careful observers, the Chinese diet as a whole must be fairly generous.

In Korea much the same foods are met with as in China, animal and vegetable foods in considerable variety being eaten. A recent writer who has studied the question states that the Koreans are hearty eaters as a race and have an even more varied diet than the Chinese.

A more or less varied mixed diet is also eaten in Indo-China, Java, and the Philippines. In Java, especially, dietary studies have been fairly numerous and indicate, as is the case with the Japanese, that, making allowances for differences in body weight, the nutritive value of the rations is much the same as those of people performing a similar amount of work under like conditions in other countries. The same conclusion has been reached regarding the Filipino diet. The natives in the Philippines depend upon rice very largely for their starchy food and use fish as their chief animal food. Fruits, vegetables, eggs, and some meat are also used.

An interesting discussion by Fink [1] of dietary conditions in India draws attention to the large amount of milk, rendered butter or "ghee," and other milk products eaten in India. In this respect native food habits are markedly different from those of China and Japan. The different sects have many different food customs, and some are apparently strict vegetarians. The bulk of the people, however, according to the writer referred to, use a mixed diet, though they differ materially as to the kind of meat eaten, some excluding beef, while others use this as well as other meats. The food of Indian natives living on a diet with little animal food and rich in energy materials has been carefully studied quite recently by D. McCay.[2] Bengali young men (students), on a diet low in protein and rich in energy, such as this portion of the Indian population usually follows, were less well developed physically and their general

[1] Jour. Trop. Med. [London], 9 (1906), p. 310.

[2] Sci. Mem. Med. and Sanit. Dept. India, n. ser., 1908, No. 34; 1910, No. 37.

condition was considered less satisfactory than was the case with Anglo-Indian and other Asiatic students living under similar conditions but on a more generous diet.

It is often said that Arabs, who are noted for their endurance, live on a few dates, but a more careful study of their customs shows that various cereal foods are also eaten; that milk or milk products are important, and that some of their most noted dishes are made with meat. Food customs vary in the different oriental countries, but on the whole it may be said that eggs, fish, poultry, meat, and legumes are well-known nitrogenous foods, and that the diet as a whole is usually seen to be adequate when compared with ordinary dietary standards, particularly when considered in relation to body weight.

It is generally true that, the more we learn about diet in remote regions, and about the kinds and amounts of food eaten, the fewer the anomalies which are found and the closer the resemblance to more familiar conditions, particularly when comparisons are made on a fair basis as regards age, body weight, and the amount of work done.

DIETARY STUDIES AND THEIR OBJECT.

If really reliable and accurate information regarding the food of a family or a race is wanted, it must be secured by means of carefully conducted studies of the kind and amount of food eaten under different conditions, the results as a matter of course being expressed in such terms and in such a manner that they may be readily compared with other similar data.

With the growth of the scientific spirit and method and its application to all branches of learning it is not surprising to find that the attempt has been made to record carefully and express in chemical terms the food habits of man in different countries, the underlying idea being that such a summary of data should show the practice of those who were in health, comfort, and vigor, whose lives were long and whose offspring were healthy, and that this would be valuable as a guide for others. Such an inference seems natural and reasonable, for it is difficult for those who believe that the human race has developed and improved as it has lived, and has constantly brought itself and its environment more nearly into harmony, to conclude otherwise than that the general customs of a race represent the accumulated wisdom of the ages of experiment and experience which have gone before.

European investigators about 1850 began to collect such information regarding dietetics and to reduce it to chemical terms, and the

average values which they found, often interpreted in the light of laboratory work, were commonly called dietary standards. Such compilations were new in form rather than in practice, for earlier students and thinkers had collected similar data and made deductions therefrom, though the results were expressed in different terms.

American investigators followed the lead of European students, Prof. W. O. Atwater, who was so long in charge of the nutrition investigations of this department, being a pioneer in the work, and a great deal of information was accumulated regarding the foods eaten by individuals and groups living under many different conditions.

USES OF FOOD IN THE BODY.

Foods are used in the body in two ways, namely, to build and repair body tissue and to furnish the body with the energy required for maintaining vital processes and for muscular work. The body cells, which make up all the organs and tissues, contain nitrogenous material as an essential, so foods containing this element are an indispensable part of the diet. Nitrogenous foods, such, for instance, as lean meat, egg white, and the gluten of wheat, contribute to the energy value of the diet, but the body depends for its energy very largely upon fats and carbohydrates, a given quantity of fat, for instance, that of butter, yielding two and one-fourth times as much energy as a similar amount of carbohydrates, such as sugar or starch.

DIGESTION AND ASSIMILATION OF FOOD.

By the digestive processes food materials are brought into proper condition for the body to use. Quite often this means that they are converted into substances which are readily soluble. The breaking up or cleavage of food constituents into simpler units which the body can utilize for growth, repair, and the performance of all its functions is very largely accomplished by the ferments present in the saliva and other digestive juices. Other important factors in the process are fineness of division secured by chewing and by the muscular movement of digestion, the warmth of the body, and the moisture of the digesting material.

The digestive processes which the food undergoes in the alimentary tract change the chemical substances of which it is composed into forms which the various organs of the body can utilize for their characteristic needs. Not all of the food eaten, however, can thus be made available for body use. The proportion differs with different materials, certain ingredients being less completely digested

than others, either because of their chemical nature or because they are presented in a form which hinders the action of the digestive juices. The true value of a food, therefore, depends not alone on the protein, fats, carbohydrates, and mineral matters which it contains, but also on the proportion of these which the digestive organs can make available for assimilation. It is a popular impression that individuals differ considerably in their powers of digestion, and to a certain extent this is true, especially among invalids and other abnormal persons. Extensive study of digestion in normal persons, however, shows that such persons digest practically the same proportions of the various nutrients as they occur in foods of different origin. So closely have these proportions been found to agree in large numbers of digestion experiments that their numerical expressions, technically known as "coefficients of digestibility," are in common use to determine the amount of nutrients actually available to the body from different food materials.

The proportion of total energy of the food which is available to the body is referred to as "availability of energy." A large number of experiments with man have been made in connection with the nutrition investigations of the Office of Experiment Stations, in which the digestibility of the nutrients and the availability of energy of foods of different sorts prepared for the table in the usual ways have been determined.

The average results for the different groups into which the foods may be divided are summarized in the following table:

Coefficients of digestibility and availability of energy of different groups of food.

Kind of food.	Protein.	Fat.	Carbohydrates.	Availability of energy.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Meat and fish	97	95	.....	87
Eggs	97	95	98	89
Dairy products	97	95	98	93
Total animal foods of mixed diet	97	95	98	89
Cereals	85	90	98	91
Legumes, dried	78	90	97	83
Sugars and starches	.....	.....	98	98
Vegetables	83	90	95	91
Fruits	85	90	90	88
Total vegetable foods of mixed diet	84	90	97	92
Total food	92	95	97	91

It will be seen that the different food materials and groups of foods as ordinarily prepared for the table vary in the thoroughness with which they are assimilated. Meats of different sorts as ordinarily prepared for the table, and indeed animal foods as a whole, are more completely digested than the common vegetable foods. Considering the food as a whole, 96 per cent of the total organic matter

is digested and 91 per cent of the energy of the food is available for digestion. In other words, the body rejects only about 4 per cent of the total nutrients and about 9 per cent of the total energy supplied by the food eaten.

METHODS OF RECORDING DIETARY STUDIES.

In the methods usually followed in expressing the results of dietary studies the functions of food, as expressed above, are had in mind, and the results attempt to show the value of the daily ration as a tissue former and an energy yielder.

The results of dietary studies and the dietary standards deduced from them have been very commonly expressed in terms of protein, fat, and carbohydrates. It is, however, simpler to express the results in terms of protein and energy only, and this is now more usually done, as these factors give data regarding both functions of the diet and constitute the simplest basis on which different foods, rations, and standards can be compared. Various attempts have been made to express the value of different foods and different diets by a single term, but this is not possible, since the two functions which food serves can not be expressed in any common unit. The dietary standard expressed in terms of protein and energy only does not, of course, take account of the proportion of fats and carbohydrates present, and from the theoretical standpoint it is not necessary to do so, as it is immaterial which of these two classes of nutrients supplies the energy. From a practical standpoint, however, the proportion is of the greatest importance on account of its relation to the wholesomeness and palatability of the diet. The proportions which are usually consumed in the American diet are not far from 150 grams fat and 350 grams carbohydrates per 100 grams [1] protein.

PROPORTIONS EATEN BY MEN AND WOMEN OF DIFFERENT AGES.

It is a matter of convenience to record the results of dietary studies in like terms as regards the age and sex of the persons included, and the amount per man per day seems the most satisfactory basis of comparison.

Everyone knows that the young child takes less food than the older, and that there are variations through adolescence to the period of full vigor and of old age. The numerous food investigations which have been carried on have furnished data for estimating the amounts consumed by children of different ages and by men and women at different periods of life, and general factors have been de-

[1] 100 grams equal 0.22 pound.

duced which are shown in the table below, and which are used in calculating the results of dietary studies to the uniform basis "per man per day."

In this comparison a man in full vigor at moderate work has been selected as the unit for comparison and assigned the value 100. The greater or smaller requirements of men at more severe work, and of women and children, are shown by values greater or less than 100, as the case may be.

Relative values for food requirements of persons of different age and occupation as compared with a man in full vigor at moderate work.

Man, period of full vigor:		Boy:	
At moderate work	100	15 to 16 years old	90
At hard work	120	13 to 14 years old	80
Sedentary occupation	80	12 years old	70
Woman, period of full vigor:		10 to 11 years old	60
At moderate work	80	Girl:	
At hard work	100	15 to 16 years old	80
Sedentary occupation	70	13 to 14 years old	70
Man or woman:		10 to 12 years old	60
Old age	90	Child:	
Extreme old age	70–80	6 to 9 years old	50
		2 to 5 years old	40
		Child under 2 years old	30

It is evident from the figures quoted that there is an increase in food consumption from infancy until full vigor and that the food requirements again diminish in old age. The figures also show that during early youth and old age sex does not have a marked effect on food requirements, but from the time growth is complete until old age a woman requires less food than a man engaged in the same kind of work. This difference, which is based on observation of the amounts eaten under average conditions, is explained as being due to the fact that woman's stature is on an average less than man's, and the amount of work, including the internal muscular work of the body, is less, the food requirements being proportional to the size of the body and the quantity of work it performs.

Data regarding the food requirements in old age are especially interesting, as comparatively little information was available on this subject until dietary studies were recently undertaken in old-age homes in Baltimore and Philadelphia as a part of the nutrition investigations of this department. The results obtained clearly show that smaller amounts are eaten when the period of full vigor has passed and that in extreme old age, when most of the day is spent in quiet and rest, the quantity of food desired is comparatively small.

SUMMARY OF RESULTS OF DIETARY STUDIES.

Though many American investigators have contributed to the study of the food of man, by far the larger part of such work in this country has been carried on in connection with the nutrition investigations of the Department of Agriculture, over 500 studies having been conducted to learn the kinds and amounts of food consumed by individuals and groups and what they represented from a chemical standpoint. Some 400 of these dietary studies have been made in families of farmers, professional men, mechanics, day laborers, and so on, and the results are believed to be fairly representative of average conditions in American homes. In all the dietary work it has been the purpose to include as many regions, as great a variety as possible in employment, materials, surroundings, and other conditions, and to include men, women, and children of different ages. The attempt has also been made, except in studies undertaken for some specific purpose, to study normal individuals in good health and not abnormal or unusual types.

The table (p. 16) summarizes the data thus collected and gives average values for different groups, the results being expressed in terms of protein and energy; that is, in such a way that they show the proportion of tissue-building material supplied and the energy value of the diet. The American dietary studies which are summarized represent averages deduced from an extensive compilation of results of studies undertaken under a great variety of circumstances, and it is believed that the results are fairly representative of actual conditions, as the work as a whole was carried on under favorable auspices. Wherever possible the table includes total protein, energy of total diet, the digested protein, and the energy utilized, the last two values being calculated when necessary by the aid of factors such as those mentioned on page 12.

The total number of investigations which have been carried on in the United States and elsewhere in connection with studies of special food problems yield data which are of decided interest and value regarding the kinds and amounts of food consumed, but it is believed that the results of such experimental studies should not be included in this discussion, which it is intended should be based on existing conditions, and not on more or less abnormal experimental conditions.

In selecting dietary studies of Europeans and others, for purposes of comparison, general averages were not available and it was necessary to choose such studies as seemed similar in purpose and method to the American work, preference being given to those which were recent and carried on with reasonable accuracy and which, so far as could be judged, represented usual and normal rather than abnormal or experimental conditions.

Results of dietary studies in the United States and other countries.

Persons.	Total protein eaten.	Energy of total diet.	Digested protein.	Energy utilized.
United States:				
Men at hard muscular work—	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Artisans, laborers, etc., average of 24 studies	[1]177	[2]6,485	162	6,000
Athletes, average of 19 studies	198	4,980	182	4,510
Men at moderate muscular work: Farmers, artisans, laborers, etc., average of 162 studies	100	3,685	92	3,425
Men not employed at muscular occupations. Business men, students, etc., average of 51 studies	106	3,560	98	3,285
Men with little or no muscular work: Inmates of institutions, average of 49 studies	86	2,820	80	2,600
Very poor working people, average of 15 studies	69	2,275	64	2,100
Canada: Factory hands, average of 13 studies	108	3,735	99	3,480
West Indies: Farmers, light work, Leeward Islands	82	.....	75	3,085
Ireland: Workingmen	98	.....	90	3,107
England: Workingmen	89	.....	82	2,685
Scotland:				
Workingmen	108	.....	99	3,228
Students	143	.....	132	3,979
Finland:				
Workingmen	114	.....	105	3,011
Workingmen (hard work)	167	.....	150	4,378
Students	157	.....	144	3,984
Sweden:				
Workingmen	134	.....	123	3,281
Workingmen (hard work)	189	.....	174	4,557
Students	127	.....	117	3,032
Russia:				
Factory hands	119	.....	109	3,194
Miners (hard work)	155	.....	143	4,000
Northern Italy: Laborers	125	.....	115	3,655
Southern Italy: Laborers	148	.....	136	4,400
Italy: Farmers and mechanics	125	.....	115	3,400
Germany:				
Workingmen (hard work)	134	.....	123	3,061
Farmers	137	.....	126	4,530
Professional men	111	.....	102	2,511
France:				
Men (light work)	110	.....	101	2,750
Farmers (south of France)	149	.....	137	4,570
Belgium:				
Workingmen	92	.....	84	3,000
Farmers	136	.....	125	4,370
Poland: Well-to-do families	121	.....	111	3,015
Japan:				
Laborers	118	.....	103	4,415
Laborers (hard work)	158	.....	137	5,050
Farmers	102	3,091	94	2,823
Professional and business men	87	.....	75	2,190
Students	98	.....	88	2,800
Java: Men (light work)	73	.....	67	2,500
Philippines: Native of Tay Tay:				
Average person	90	2,700	83	2,457
Man at hard work	100	3,100	92	2,821
China, Lao-Kay: Laborers	91	.....	83	3,400
Anam: Laborers	134	.....	123	3,866
Egypt: Native laborers	112	.....	103	2,825
Congo: Native laborers	108	.....	99	2,812

[1] 100 grams equal 0.22 pound.
[2] The calorie is the unit used to measure heat. One calorie equals nearly 1.54 foot-tons.

In the above comparison the values for the United States represent the averages of a large number of studies. In the case of the dietaries selected for comparison it has been the object to take the mean rather than the extreme values. It will be seen that all things considered the range in both protein and energy is comparatively wide; this is true whether nutrients consumed or nutrients digested are considered. If, however, the results are considered as a whole, it becomes apparent that the majority of them do not differ very markedly from a general average and that it is fair to say that although

foods may differ very decidedly the nutritive value of the diet in different regions and under different circumstances is very much the same for a like amount of muscular work. In this connection it is interesting to quote the conclusion reached by Paton and Dunlop,[1] of Edinburgh, with respect to this question:

> The study of the ordinary diets of the laboring classes in all countries seems to show that whenever possible a diet is secured which will yield something over 3,000 calories of energy and over 100 grams of proteids per man per diem.

It seems probable that, as these authors suggested, so many varied races could not be mistaken in their food demands and that this quantity does approximately represent the demand of the body for nourishment under the given circumstances.

FACTORS WHICH AFFECT FOOD REQUIREMENTS.

The average requirements of a normal individual are affected by a number of factors, of which the most important are sex, age, size of the body, and the amount of muscular work performed. The last mentioned is by far the most important after the body has gained its normal size, at least as regards the energy value. Other factors which have an influence on food requirements are climate, the bearing and nourishment of children, the pathological conditions due to diseases of different sorts, and various abnormal conditions. Of these factors the influence of age and sex have been considered in a preceding section (p. 14). As regards climate and seasons, the general conclusion reached is that more energy is required in cold than in warm weather, and it has been estimated that in winter the energy requirement is greater by 800 calories than in summer. Acute and chronic diseases and other abnormal conditions have a very decided effect on protein and energy requirements, and a knowledge of such conditions with reference to the kind and amount of food needed must form the basis of rational invalid dietetics, one of the most important subjects in the practice of medicine.

Just as some persons apparently normal in other respects can not distinguish between certain colors, so others are apparently in perfect health and vigor, whose food requirements differ markedly from those of the average normal individual. Such exceptions are interesting, but need not be considered in general discussions of protein and energy requirements.

EFFECT OF SIZE ON FOOD REQUIREMENTS.

The average stature and weight of individuals of different races vary decidedly, a fact which is well known and which is easily proved by consulting military statistics regarding the height and

[1] Proc. Roy. Soc. Edinb., 25 (1904–5), p. 498.

weight of soldiers and similar reliable data. Such facts, however, are often disregarded in discussing the results of dietary studies, though no one can doubt that it is more accurate to discuss dietary standards and similar questions on the basis of a unit of body weight or some such factor than simply on the per man per day basis. If allowance is made for variations in body weight, figures for amounts of nutrients and energy eaten per man per day, which at first sight seem very dissimilar, are after all found to resemble each other quite closely. For instance, the results of 14 dietary studies with American professional and business men showed that they consumed a diet which supplied 104 grams protein and 3,220 calories of available energy, and with Japanese of similar employment, as shown by 13 studies, 87 grams protein and 2,190 calories of energy. The Americans weighed on an average 150 pounds and the Japanese 105 pounds. If we compare the two sets of figures on the basis of a uniform weight of 150 pounds, the values for the Japanese become 105 grams protein and 3,120 calories of energy. According to a recent report the diet of young Japanese Buddhist monks supplied 57 grams protein and 1,807 calories of energy. If the diet, which seems at first sight so low in protein and energy, is considered on the basis of 150 pounds body weight, the food eaten would supply 88 grams protein and 2,769 calories.

It is obvious that a uniform basis for making comparisons should not be overlooked in discussing this and other questions of food and diet.

MUSCULAR WORK IN RELATION TO FOOD EATEN AND REQUIRED.

Muscular exertion—that is, the amount of physical work performed—is one of the most important factors which determine the amount of food eaten. Everyone recognizes the fact that hard work means a hearty appetite. The effect of muscular work on food consumption is plainly shown in dietary studies carried on with Maine lumbermen, who, while engaged in chopping and yarding, ate food supplying 221 grams protein and 8,140 calories per day. When drawing logs the lumbermen ate 179 grams protein and utilized 6,835 calories of energy per day, amounts which are still large as compared with the food of men at less active employment. These men were engaged in very severe out-of-door work in a very cold climate, and the amount of food which they ate is very much greater than is eaten by men of similar size on New England farms or in New England factories, who have been found to eat on an average about 100 grams protein and to utilize about 3,425 calories of energy.

It has long been known to physiologists that nitrogen-free nutrients are the chief source of the energy expended in muscular work

under usual conditions. It was found that the lumbermen showed a decided partiality for foods rich in carbohydrates and fat, and that the amount of pastry, sirup, sugar, baked beans, and similar materials eaten was unusually large and accounted for the high energy value. The amount of protein supplied by the diet was also high, partly, perhaps, because, with the available foods and the previously acquired food habits, it would have been difficult to secure a sufficient amount of nitrogen-free material without a correspondingly large amount of protein.

DIETARY STANDARDS.

As a result of the dietary studies which have been made and other data, certain dietary standards have been devised which, it is believed, may serve as useful guides for home management. The following table gives such data for a man at moderate muscular work, on the basis of food purchased, food eaten, and food digested.

Dietary standard for man in full vigor at moderate muscular work.

	Protein.	Energy.
	Grams.	*Calories.*
Food as purchased	115	3,800
Food eaten	100	3,500
Food digested	95	3,200

It has been found that the waste in the average American home ranges from nothing to as high as 20 per cent of the food purchased. A fair average would be about 10 per cent. In estimating the suggested dietary standards on the basis of food purchased and food eaten, these factors and experimental data on the subject have been taken into account. As shown by the results of a large number of digestion and metabolism experiments (see p. 12), the body assimilates on an average about 92 per cent of the total protein and utilizes about 91 per cent of the total energy of the food consumed. The dietary standard suggested on the basis of food digested takes into account such factors. The energy value also makes allowance for the energy of matter lost in the urine as well as in the feces. These dietary standards differ somewhat from those which have been proposed in earlier publications of the department, chiefly for the reason that they are based on a larger amount of accurate data than was formerly available.

The fact has always been recognized that the dietary standards proposed were subject to change as information accumulated, and it has been repeatedly stated in department publications that they

were not considered as final and were proposed as guides for home and institution management rather than as representative of absolute body requirements.

DIETARY STANDARDS VERSUS PHYSIOLOGICAL REQUIREMENTS.

As will be seen by reference to the table on page 16, which represents the results of a very large number of dietary studies, much variety in protein consumption is noted, more, indeed, than is the case with energy, and this is true, as data would show, whether the comparison is made on the basis of a pound of body material or a square yard of body surface.

The quantity of protein actually required by the body is a very important matter, and a question which it seems fair to say is as yet by no means solved, as is evidenced by the great variety of opinions which are held on the subject. This being the case, all who are interested should be open minded and welcome all contributions to the subject, and there is much ground for believing that eventually the many questions which arise can be answered, and the difference in theories regarding diet will tend to disappear. In the meantime it seems fair to conclude that as a basis for home management the values given in the so-called dietary standards are reasonably good guides, for these values represent the averages of a large number of studies made with people who led efficient lives under normal conditions. It must be remembered that a dietary standard is designed to aid in the intelligent selection and preparation of food, and is not an attempt to express exact physiological needs.

Dietary standards should be in reasonable harmony with physiological demands, and it seems probable that such is the case with those which have been most generally used. That this is true of energy can be shown by the experiments which have been made with the respiration calorimeter in connection with the nutrition investigations of the Office of Experiment Stations. It is obvious that the minimum energy requirement can hardly be less than the energy output of a fasting man without active muscular work. This value has been found to be as low as 1,550 calories per day for a man of ordinary size. Every muscular movement increases the heat output, and hence the energy requirement of the body. A man at ordinary work, such as that of a mason or a carpenter, would eliminate at least 1,200 calories of heat in the performance of his work for ten hours, as has been shown by the respiration calorimeter experiments with muscular work of different degrees. This quantity added to the 1,550 calories mentioned above would give a total of 2,750 calories, or only 500 less than is called for by the suggested dietary standard; but allowance must also be made for the energy involved in walking to and from

work and for certain internal muscular work of the body, and 500 calories is certainly not an unreasonable allowance for such demands.

The above estimates are believed to be conservative, and it therefore seems apparent that the energy value in the suggested dietary standard is reasonable and in accord with body requirements as experimentally demonstrated.

In the case of protein the question can not be so readily settled, and it seems not unlikely that the amount of protein required varies with different individuals and with the same individuals at different times, being influenced by many conditions, some of which are not now understood. That protein requirement is intimately related to the amount of phosphorus, calcium, and other mineral constituents needed or to the form in which they are supplied to the body seems probable from experiments which have been made with farm animals and from other evidence.

Proteids are complex bodies built up of a number of constituent parts linked together into a whole which possesses definite characteristics. During digestion the protein molecule is split up into simpler substances. From these the body selects and utilizes those needed for the building and repair of tissue, and apparently breaks down still further and excretes those which are not needed. In other words, the body resembles a builder who selects and uses for the various purposes for which they are suited, materials saved when an old house has been torn down and throws aside the materials for which he can find no further use.

Proteids vary greatly in the number and character of the cleavage products which they yield when broken down in the digestive tract, and this fact is believed to be very important when it comes to meeting the protein demand of the body, as it is conceivable that some proteids might supply all the needed protein units for building material, while others might be lacking in one or more such units. It also seems probable that several proteids of different origin might more reasonably be expected to furnish the needed units for body building and repair than a single proteid. Considerations such as these are of the greatest importance in discussing protein requirement.

In any case it may be said with certainty that there is a minimum quantity of protein, without which the body functions can not be carried on, and a maximum amount to exceed which would be dangerous.

The minimum amount has been estimated by a number of observers as about 35 grams per day for a man weighing 150 pounds. There are reasons for believing that, granted an abundance of carbohydrate and fatty foods of suitable character, and other favorable conditions, the quantity might be still further lowered, but

eventually a value would be reached below which a man could not live upon the ration, no matter how much nonnitrogenous material is supplied. The upper protein limit has apparently not been fixed experimentally, but it must be fairly large, as some races, notably the Esquimo and the natives of the extreme southern part of South America, in favorable seasons at least, must secure large quantities from their almost exclusively animal diet. Many observations have been made in which the amounts of protein consumed were large, 400 to 500 grams per day having been supplied in some cases. If the entire energy value of the diet were supplied by protein some 750 grams, or 1.65 pounds, would be needed to yield 3,000 calories. Doubtless no one would suggest that either the minimum or the maximum protein value represented the optimum for a man in health living under normal conditions.

Many attempts have been made to learn by observation, experiment, or other method the most satisfactory value, all things considered. The various dietary standards which have been proposed at different times, and the estimates of physiological requirements suggested as guides for daily living by a number of investigators all fall within the extreme limits referred to above. The fact that so many different opinions exist is a clear indication that the question of protein requirement is one which as yet is neither thoroughly understood nor definitely settled. That the values called for by the commonly accepted dietary standards are rational guides for the feeding of individuals, families, and groups living under usual conditions seems to be an opinion which is commonly held.

MINERAL MATTER REQUIRED IN THE DIET.

To be most useful, dietary standards should take into account the amount of ash constituents required by the body, for it is well known that mineral matters of different sorts are essential for use in forming bones and other body tissues for the repair of the body and for other purposes. Many general statements are met with regarding the great importance of mineral matter, and many theories of nutrition have been based to a large extent on mineral constituents. Experimental investigations, particularly physiological studies along these lines, are not very numerous. A recent estimate of the mineral matter required per man per day calls for the following amounts:

Estimated amount of mineral matter required per man per day.

	Grams.		Grams.
Phosphoric acid (P_2O_5)	3–4	Calcium oxid	0.7 –1.0
Sulphuric acid (SO_3)	2–3.5	Magnesium oxid	0.3 –0.5
Potassium oxid	2–3	Iron	0.006–0.012
Sodium oxid	4–6	Chlorin	6 –8

Other mineral elements, as silica, iodin, and fluorin, are required, but apparently in much smaller quantities. It is doubtful whether a moderate alteration in the absolute quantity or the mutual relation of the ash constituents of foods plays such an important part in nutrition as is sometimes claimed, but there is no doubt that in the long run the body must be supplied with the requisite amount of mineral matter of different sorts, in order that it may be normally nourished. This question is one of the subjects taken up in connection with the nutrition investigations of this department, and important results, especially with iron, calcium, and phosphorus, have already been obtained. In general, it is evident that the quantities of ash constituents required by the body are small as compared with the quantities of protein and energy.

The very numerous studies of ash constituents of different food products which have been reported by agricultural experiment station investigators and others show that nearly all the ordinary foods of both animal and vegetable origin furnish some of these constituents. There is good reason to believe that with the ordinary mixed diet the body demands for mineral matter may be met, and that when for any reason a deficiency of some ash constituent exists it may be supplied by using certain of the usual foods in greater proportion. For instance, a deficiency of calcium may be readily corrected by using larger amounts of milk and cheese, or of iron by using larger quantities of green vegetables, fruits, and the coarser milling products of the cereal grains.

ADEQUACY OF THE AVERAGE AMERICAN DIET.

It is interesting to note that the results of dietary studies made throughout the United States do not indicate any probability of general undernutrition. In many cases families were living on a very limited diet that might be much improved as regards the kinds and amounts of food eaten, but such cases were almost exclusively found in studies made with people of such limited incomes that they were living below what has been termed the "poverty line." In the great majority of families and groups which have been studied the food has been abundant, though it can be said with equal fairness that many opportunities exist for improvement as regards the rational selection of foods, their economical preparation and use, and along other similar lines.

That persistent overfeeding is harmful, no one would deny. That grave errors may also attend the long-continued use of a diet which is markedly deficient in nitrogenous material seems clear from the conditions which are noted in families or larger groups forced by

circumstances to live for long periods of years on such a diet. As an instance may be cited the Indian natives referred to on page 9. It seems almost invariably the case that such families or groups are in less satisfactory physical condition and have a lower productive capacity for useful work than similar families and groups living under more generous conditions. As another instance may be cited poor families studied in New York, whose diet was limited and whose physical condition was much inferior to that of families similarly situated except for a more generous diet.

This view of the subject, which is advanced by many physiologists and held by many students of nutrition of wide experience, was set forth in a paper by the distinguished German physiologist Rubner.[1] In his opinion the long-continued use of a diet of low nutritive value and composed largely or exclusively of vegetable foods, such as are commonly eaten by the poorer people in many regions of Europe, is responsible for defective physical condition and lessened capacity for work, increased amount of illness, higher death rate, lower resistance to epidemic diseases, and similar undesirable results. The numerous inquiries which have been made under state or government auspices into this question of physical deterioration and the almost unanimous conclusion that it is connected with some form of undernourishment give additional point to Rubner's deductions.

Much light is thrown on the possible relation between continued limited diet and retarded or arrested development by such an investigation as that carried on by H. J. Waters[2] at the Missouri and Kansas experiment stations on the influence of nutrition upon the animal form, and by H. Aron's[3] investigation on a similar subject. The fact that the food supply materially influences the development of the animal body is of particular importance in respect to the diet of young children and clearly shows that there is good reason for the general belief that in childhood the diet should be generous as well as composed of suitable food materials.

A special phase of the question which has recently received much attention is that of underfeeding among the children in the public schools. There seems little doubt that many children in the congested sections of American cities are decidedly undernourished, though this condition seems less widespread than in some European cities. Wherever it exists this underfeeding is an important factor in the arrested physical and mental development and also in the tuberculosis and other diseases which are so prevalent in such con-

[1] Rev. Hyg. et Pol. Sanit., 29 (1907), p. 854.
[2] Proc. Soc. Prom. Agr. Sci., 30 (1909), p. 70.
[3] Biochem. Ztschr., 30 (1910), p. 207.

gested centers. It is not only that many parents can not provide sufficient food for their children, but also that they frequently provide the wrong food, or give the children pennies with which to buy their own lunch, with the natural result that they are spent for candy, chewing gum, or questionable push-cart goods.

To meet this difficulty school lunches are provided in districts where they are needed in some cities in this country, and much more generally in Europe. Sometimes the food is furnished by the municipal authorities, sometimes by private charitable agencies working through the school organization. In some cases it is served free to all, in others sold at a trifling sum to those who can afford to purchase it. In this way each child is sure of at least one nutritious and suitable meal a day. In schools where this has been tried improvement not only in the physical but also in the mental condition of the pupils seems invariably to follow, and in the opinion of most school officials of experience the matter can be so managed that it brings no danger of pauperization. As in the case of school lunches prepared in connection with domestic science courses (see p. 30) the children may at the same time be given important object lessons in the proper cooking and serving of food.

Fortunately for the United States, the question of physical deterioration can not be raised with reference to the people as a whole. The large capacity for useful labor and the high average reached as to the grade of work performed are conceded by careful students of this subject in this country and elsewhere. The comparatively high standard as regards family and community hygiene and sanitation, and other similar factors, undoubtedly have a bearing on these questions, but no one can doubt that diet exercises an influence, which is certainly not less great than any other single factor, and the American diet as a whole is varied and liberal.

KINDS OF FOOD EATEN IN AMERICAN HOMES.

Owing to great range in climate and agricultural conditions, the United States yields food products in great variety, as well as in great abundance. Methods of transporting, storing, and distributing food products have kept pace with improved methods of cultivation, and perhaps at no time and in no country has there been greater variety of products of the farm, field, ranch, and garden from which to select than in the United States to-day.

In connection with the dietary studies which have been made under the auspices of this department, data have been summarized which show the proportionate amounts of different foods which make up the diet of the average American home, and the relative proportion of

the total nutrients and energy which the principal foods and food groups supply. A summary of such data based on the results of about 400 studies is presented in the table which follows:

Proportion of nutrients furnished by different food materials in the average American dietary.

Food materials.	Total food material.	Protein.	Fat.	Carbohydrates.
ANIMAL FOODS.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Beef and veal	7.2	16.7	13.2	.....
Lamb and mutton	.9	2.1	2.6	.....
Pork, including lard	7.2	9.3	42.1	.....
Poultry	.7	1.6	.9	.....
Total meats	16.0	29.7	58.8	.....
Fish	1.8	3.5	1.0	.....
Eggs	2.1	4.1	2.9	.....
Butter	1.6	.3	16.6	.....
Cheese	.3	1.0	1.1	.....
Milk and cream	16.5	8.7	8.0	3.6
Total dairy products	18.4	10.0	25.7	3.6
Unclassified animal foods	.2	.2	.2	.3
Total animal foods	38.5	47.5	88.6	3.9
VEGETABLE FOODS.				
Wheat flour, patent	12.2	19.4	1.5	25.6
Wheat flour, entire	.1	.1	.....	.2
Wheat flour, graham	.1	.2	.....	.2
Wheat preparations	.3	.5	.1	1.0
Wheat bread, patent	5.8	8.1	1.6	12.4
Wheat bread, entire	.....	.....	.....	.1
Wheat bread, graham	.1	.1	.....	.2
Crackers	.3	.5	.5	1.0
Sweet cakes, etc	.6	.8	.9	1.4
Corn meal and flour	8.7	10.1	3.8	13.7
Corn preparations	.2	.2	.1	.4
Oatmeal and preparations	.5	1.0	.5	1.1
Rice	.3	.3	.....	.9
Rye	1.3	1.6	.1	3.1
Barley and buckwheat	.1	.1	.....	.5
Total cereals	30.6	43.0	9.1	61.8
Sugar, molasses, etc	5.4	.....	.....	17.5
Starch (prepared)	.....	.....	.....	.1
Dried legumes	1.0	2.9	.2	1.7
Fresh legumes	.6	.4	.....	.3
Tubers and yams	12.5	3.8	.3	8.3
Other vegetables	6.2	1.6	.5	1.7
Total vegetables	20.3	8.7	1.0	12.0
Fresh fruits	3.8	.3	.3	2.5
Dried fruits	.6	.2	.1	1.2
Total fruits	4.4	.5	.4	3.7
Nuts	.....	.....	.1	.....
Unclassified vegetable foods	.5	.1	.2	.6
Total vegetable foods	61.2	52.3	10.8	95.7
Miscellaneous food materials	.3	.2	.6	.4
Total food materials	100.0	100.0	100.0	100.0

As will be seen, the number of foods which may be called staples and which make up the bulk of the diet is comparatively small, in-

cluding such articles as wheat flour, meat, milk, butter, dairy products, and vegetables.

It will be seen further that animal and vegetable foods are about equal in rank as sources of protein, some 48 per cent of the total being supplied by animal foods and 52 per cent by vegetable foods, of which 43 per cent is contributed by the cereals. Little fat is furnished by vegetable foods, the group, as a whole, supplying only 11 per cent of the total amount in the diet. Animal foods and dairy products are the most important sources of fat, milk and cream furnishing 26 per cent of the total fat of the diet, and meat, as a whole, furnishing a little over twice as much as is supplied by all other animal foods. Of the different meats, pork is the most important source of fat. Meats and poultry together furnish about twice as much protein as the other animal foods, and of the different meats, beef and veal together furnish about half of the total amount supplied by the entire group.

The table on page 26 does not show the relative amounts of the different kinds of foods which are expensive and which may be classed as luxuries rather than staples, but it is obvious that such foods do not supply a very large proportion of the total nutrients and energy, since the groups (e. g., "other vegetables," "fresh fruits," etc.) in which they are mostly included are not large factors in the totals.

VARIETY IN DIET IN RELATION TO COST.

In general, it may be said that, other things being equal, the cost of the daily food is determined by the proportion of the total expended for such staple articles as bread, meat, butter, eggs, and common vegetables, and the expenditure for accessory foods, such as expensive fruit, out-of-season vegetables, fancy sweets, and the like, which, as ordinarily used, contribute more to the attractiveness of the diet than they do to its nutritive value. As an instance, may be cited the results obtained with a workingman's family in New Jersey in comfortable circumstances. The total expenditure for food during the period covered by the dietary study was $34.95. Of this, $5.16, or 14.8 per cent, was paid for oranges and celery, which together furnished only 150 grams protein and 6,445 calories of energy, or about 1 per cent of both total protein and total fuel value. During the same period the expenditure for cheaper vegetables and fruits, such as potatoes, cabbage, sweet potatoes, apples, canned tomatoes, canned peaches, etc., was $5.75, and this supplied 1,909 grams protein and 58,000 calories of energy. The expenditure of $5.16 for cereal foods and sugar furnished 3,375 grams protein and 184,185 calories of energy, or about twenty-five times the amount supplied by the celery and oranges. The oranges and celery undoubtedly added to the attractiveness of the diet, and nothing can be said against their use provided

the cost of the diet is reasonable in proportion to the family income. It is true, however, that such foods could have been omitted from the diet without materially changing its nutritive value, while the cost of the daily food would have been considerably lowered; or other articles which would have helped make the diet attractive but which were of lower cost might have been used in place of the oranges and celery.

An opportunity may be found for lessening the expenses in many families by cutting down the waste, particularly in such foods as meat, butter, and others which are comparatively expensive. The results of some 200 dietary studies in the United States show that as noted above (p. 19) the total waste ranges from little or nothing to about 20 per cent of the total food in the average family. In a family in fairly comfortable circumstances which can perhaps be regarded as representative, the animal food wasted was found to contain about 3 per cent of the total protein and 2 per cent of the total energy of the food purchased, and the vegetable food wasted about 1 per cent of the total protein and 2 per cent of the total energy. Careful buying, good cooking, and careful serving to suit the demands of individual appetites in the family so that little is left on plates to be thrown away are important factors in economical living, as is also the careful use of all material left over in the kitchen or on the table after the family has been served.

This generally means a greater demand upon the housekeeper's time, whether she does her own work or whether she superintends it, but is essential if saving is to be effected. In all such problems the value of the thing saved must of course be considered in relation to the time and expense incurred in saving it. For instance, it would not be a saving to bring home a half pound of fat trimmings from a beef roast and render it if it required time which might be profitably used otherwise, and a fire when a hot stove was not needed for some other purpose. Nevertheless, the principle holds good that an actual lessening of expenses is possible in the average home if the problem is carefully and intelligently considered.

It is in the combination, with due reference to economy, of staple articles, many of them lacking in distinctive flavor, with foods and dishes which possess flavor in marked degree that one of the greatest opportunities for skillful management in the household occurs.

Another problem of importance in this connection is the ease and economy of preparation of food in relation to its cost. A cheap cut of meat, like shoulder clod, can not be so readily served in attractive form as a choice steak. The cheaper cut requires much longer cooking and consequently more fuel and labor, and to be at its best should be cooked with seasoning vegetables or prepared in some

similar way which secures flavor. Other cases like this are too well known to need mention. True economy consists in so adjusting such problems to the family income that palate and purse may each have its due.

The housewife who can appreciate and apply the available knowledge regarding the relative cost of different methods of cookery, fitting combinations of food, the relation between composition and cost, and similar factors can supply wholesome diet suited to her family needs at a much more reasonable cost than is the case when such knowledge is disregarded. That this is a fact is readily demonstrated by the studies in housekeeping on a wholesale scale which have been made in public institutions, for instance, at Bayview, a large public institution in Baltimore. In this institution diet has been made to conform, as regards nutritive value, to commonly accepted dietary standards, and much thought has been given to the selection and preparation of foods so that the diet may be suited to the physical needs of the persons receiving it (many of them elderly persons) and may be reasonably varied and palatable while at the same time it is very low in cost. The dietary determined upon with these requirements in mind has proved satisfactory after a test of a number of years.

In studies [1] which were made under conditions more comparable to those of family life, it was demonstrated that diet, adequate as regards nutrients, energy, and palatability, can be supplied at low, at moderate, or at high cost, and that the differences in cost depend much more on the proportion of fancy dishes and elaborate cooking and high-priced luxuries than they do upon variations in nutritive value.

IMPORTANCE OF SCIENTIFIC DATA IN HOME MANAGEMENT.

Many housekeepers are very wise in questions of home management and understand the art of housekeeping so well that they secure the desired results with the empirical knowledge gained by experience and handed down from mother to daughter. The problems pertaining to food and diet have received a very large amount of study during the last 50 years, and the explanation of many facts on which empirical knowledge was based has been found, and a large body of valuable information is now available, much of which has been so systematized that it can be readily taught. That this is the case is shown by the large number of high schools and other educational institutions which give courses in home economics and by the success which has attended this kind of teaching. It is certainly true that system and coordination can be taught with respect to the

[1] U. S. Dept. Agr., Office Expt. Stas. Bul. 129.

purchase of food and the management of dietetic problems in the same way that they can be taught with reference to manufacturing problems or other business enterprises. In both cases some of the facts systematized and arranged have been newly acquired by experimental study, while others are the result of experience and have been handed down from past generations.

The increasing number of girls who are each year receiving systematic instruction in the various branches of home economics in the schools should make it certain that future housekeepers have an intelligent understanding both of the act of home making and of the fundamental scientific principles which lie behind it. Many of these school courses are so arranged that they benefit not only the girls following them, but other scholars as well. In several schools the home economics classes prepare the lunches for the entire school; in this way all the pupils get a more distinct and systematic idea of what suitable, well-cooked meals are and how they should be served, while the added expense to the school is very slight. Whether prepared by domestic-science classes or not school lunches can be made to give very useful object lessons in table manners and general personal neatness. In congested city districts these lunches, served and eaten with simple decorum, such as would be insisted on in a well-bred home, give some of the children their first intimation that a meal can mean more than mere eating and drinking. Even for more carefully reared children such lunches are a great improvement over a cold sandwich brought from home and gulped down at recess or a dish of possibly old and dirty ice cream from the inevitable push cart. In country schools where the pupils have to eat their noon meal at the schoolhouse the matter is fully as important as in the cities. In some such cases teachers and scholars join in preparing as well as in eating the food. Where this plan has been tried it has been found that in spite of the work involved the lunch hour is one of the pleasantest of the day to the children, and it goes without saying that clean hands and good manners are insisted on. Since, as physiologists agree, digestion is best accomplished when food is eaten slowly and the mind is pleasantly occupied, the habit of eating meals properly is almost as important in a child's training as is an abundance of food. Moreover, the family table is the social meeting place of the family and any influence that the schools have in making it more attractive must prove a distinct benefit to home life.

This whole question has been discussed in an article on the daily meals of school children by Caroline L. Hunt,[1] published by the United States Bureau of Education.

[1] U. S. Bur. Ed. Bul. No. 3, 1909.

The problems of economy in living differ in town and country. The farmer's wife has her vegetables, fruits, poultry, and dairy products without a cash outlay, while the housewife in the city must purchase everything. In the case of market facilities, however, and prices which must be paid for many staple foods, the advantage seems to lie with the careful buyer in the large town or city. The small town with its garden and other opportunities for home production of food products is, of course, midway between the city and country. Housekeepers in towns probably have the advantage of those in the country in the number of kitchen and household conveniences with which their homes are furnished. Farmers and their wives are, however, coming to recognize more and more the importance of running water, good drainage, ice supplies, and such labor-saving devices as bread mixers and washing machines, and to realize that all these things raise the standard of home life as well as lessen the work of the housekeeper. Aside from the home economics courses, which are fully as well developed in many agricultural as in urban schools, much organized effort is being made to give women in rural homes the benefits of modern knowledge of home science, as witness the help offered by the various phases of the educational extension movement, the women's club movement, the women's departments in farmers' institutes, the national grange, and similar enterprises.

Each region has its attractions and its special advantages, but the underlying principles with respect to economical home management are the same in every locality. It is with a view to helping the housewife to solve her problems that studies of the kind and amount of food eaten, the relative nutritive value of different foods, the comparative economy of different methods of cooking, and related questions have been undertaken by this department.

For many years the Department of Agriculture cooperated with agricultural colleges, experiment stations, and other institutions in its nutrition work, but as at present organized the nutrition investigations of the Office of Experiment Stations are carried on in Washington, the plan being to study problems of especial interest in connection with the work of the department, and cooperation with other bureaus is involved. The respiration calorimeter, an instrument of great precision for measuring the income and outgo of matter and energy, and accessory apparatus, are used in the experiments. In addition to experiments such as these, attention is given to dietary studies, to digestion experiments, to studies of the comparative value to the body of different foods, to the relative economy of different cooking processes with reference to nutritive value, and to related problems.

Briefly, the purpose of the nutrition investigations is to study various aspects of the problem of the value for human food of agricultural products, both animal and vegetable. Numerous reports of investigations of nutrition problems have appeared as technical bulletins, and some of the more important results, as well as general data, have been summarized in farmers' bulletins and circulars and similar publications.

CONCLUSION.

An extended survey of the literature of food supply and of the food habits of many races makes it plain that no country has a greater variety of readily accessible foods of good quality than the United States and in none is there a more general use of a wide range of articles. Thanks to the varied climate, the ready means of transportation, and the facilities for marketing and handling food products, the contributions of any given locality are readily accessible in other regions. Skill in selecting from this great variety of food products and in the preparation of foods after they are purchased is essential if out of such abundance a diet is to be secured which is best suited to the needs of the American people. The dietary studies summarized above and other similar reliable data seem to show that the people of the United States as a whole are adequately nourished as compared with other races. The acknowledged energy and achievement of the American people, together with their general good health and physical well-being, certainly indicate that they have in the main used their food resources advantageously.

[Cir. 110]

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